

WHAT IS CLAIMED IS:

1. A liquid image formation apparatus comprising:
 - a latent image carrier which carries a latent image on its surface;
- 5 a developer carrier which carries a liquid developer consisting of a carrier liquid and toner dispersed therein, on its surface; and
 - an applying unit which applies said liquid developer to said developer carrier in a predetermined width,
- 10 said liquid image formation apparatus for developing the latent image by said liquid developer carried on said developer carrier, in a development area as an area where said developer carrier and said latent image carrier face each other, further comprising:
 - 15 a removing unit, which removes excess toner on said latent image carrier after development, located downstream said development area in a direction in which the surface of said latent image carrier moves,
 - wherein an area, in which said removing unit removes
 - 20 excess toner, on the surface of said latent image carrier is made broader than an area in which said applying unit applies said liquid developer onto the surface of said latent image carrier.

2. The liquid image formation apparatus according to
claim 1,

wherein said removing unit is a removing member which
is provided facing said latent image carrier and removes
5 excess toner on the surface of said latent image carrier
by transferring said excess toner on said latent image
carrier surface thereto, and said removing unit comprises:

a removing-member cleaning member which is in contact
with the surface of said removing member for carrying said
10 excess toner and removes said excess toner on the surface
of said removing member, and

a width in a main scanning direction of said
removing-member cleaning member covers the whole area in
the width direction with respect to the main scanning
15 direction of said removing member, and is made wider than
a width in the main scanning direction of said removing
member.

3. The liquid image formation apparatus according to
20 claim 1, further comprising:

a charger which uniformly charges the surface of said
latent image carrier; and

an exposing unit which performs exposure to form an
image portion and a non-image portion on a uniformly-charged
25 area that is uniformly charged by said charger,

wherein said removing unit is a removing member which
is provided facing said latent image carrier and removes
excess toner on the surface of said latent image carrier
by transferring said excess toner on said latent image
5 carrier surface thereto, and

said uniformly-charged area is formed so as to cover
the whole area of an area where said removing member faces
said latent image carrier.

10 4. The liquid image formation apparatus according to
claim 1, further comprising:

a transfer unit which transfers an image formed on
the surface of said latent image carrier after development
to a transfer medium,

15 wherein an area, in which said removing unit removes
excess toner, on the surface of said latent image carrier
is made broader than a transfer-medium facing area in which
said transfer medium faces the surface of said latent image
carrier.

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5. The liquid image formation apparatus according to
claim 1, further comprising:

a transfer unit which transfers an image formed on
the surface of said latent image carrier after development
25 to a transfer medium; and

a latent image carrier cleaning unit which cleans the surface of said latent image carrier after the image is transferred to said transfer medium,

wherein said removing unit is a removing member which 5 is provided in contact with said latent image carrier and removes excess toner on the surface of said latent image carrier by transferring said excess toner on said latent image carrier surface thereto, and

an area, in which said latent image carrier cleaning 10 unit cleans the surface of said latent image carrier, covers the whole area of the contact area of said removing member with said latent image carrier and is made wider than the width in the main scanning direction of said removing unit.

15 6. The liquid image formation apparatus according to claim 1, further comprising:

an excess toner recycle unit which recycles excess toner removed from the surface of said latent image carrier by said removing unit, for development.

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7. The liquid image formation apparatus according to claim 1, further comprising:

a transfer unit which transfers an image formed on the surface of said latent image carrier after development 25 to a transfer medium; and

an after-transfer residual toner cleaning unit which cleans residual toner after transfer remaining on the surface of said latent image carrier after an image is transferred to said transfer medium, said apparatus further including:

5 an after-transfer residual toner recycle unit which recycles the after-transfer residual toner removed from the surface of said latent image carrier by said after-transfer residual toner cleaning unit, for development.

10 8. A liquid developing device which applies a liquid developer consisting of a carrier liquid and toner dispersed therein, to an elastic developing roller, brings said developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed,
15 develops the electrostatic latent image using said liquid developer applied to said developing roller, and removes said toner adhering to a background portion of said latent image carrier with a sweep roller,

wherein said developing roller can come into contact
20 with and separate from said latent image carrier.

9. The liquid developing device according to claim 8,
wherein said developing roller and said latent image carrier
rotate together with each other when said developing roller
25 comes into contact with or separates from said latent image

carrier.

10. The liquid developing device according to claim 8,
wherein said developing roller has said liquid developer
5 adhered to its surface when said developing roller comes
into contact with or separates from said latent image
carrier.

11. The liquid developing device according to claim 8,
10 wherein a predetermined potential is applied to said latent
image carrier so that toner is prevented from movement from
the surface of said developing roller to said latent image
carrier when said developing roller comes into contact with
or separates from said latent image carrier.

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12. A liquid developing device which applies a liquid
developer consisting of a carrier liquid and toner dispersed
therein, to an elastic developing roller, brings said
developing roller by pressure into contact with a latent
20 image carrier where an electrostatic latent image is formed,
develops the electrostatic latent image using said liquid
developer applied to said developing roller, and removes
said toner adhering to a background portion of said latent
image carrier with a sweep roller, wherein the following
25 relation holds:

$$d_1 / v < 0.5$$

where a distance from said developing roller to said sweep roller in the rotating direction of said latent image carrier is d_1 , and linear velocity of said latent image carrier is v , and wherein a unit of the distance d_1 is mm and a unit of the linear velocity v of said latent image carrier is mm/sec.

13. The liquid developing device according to claim 12,
10 wherein

$d_2 / v < 0.7$, where a distance from said sweep roller to a transfer position in the rotating direction of said latent image carrier is d_2 .

15 14. The liquid developing device according to claim 13,
wherein said latent image carrier is a photoreceptor formed
of amorphous silicon.

15. A liquid developing device comprising:
20 at least one developer carrier which carries a highly viscous and highly concentrated liquid developer consisting of a carrier liquid and toner dispersed therein; and an applying member which applies said liquid developer to said developer carrier,
25 said liquid developing device for developing a latent

image formed on a latent image carrier by said liquid developer carried on said developer carrier, further comprising:

- at least one sweep roller formed of an elastic body
- 5 for removing excess developer on said latent image carrier after development, located downstream said developer carrier in a direction in which the surface of said latent image carrier moves;
- a nip forming unit which forms a nip between said sweep roller and said latent image carrier;
- 10 a sweep voltage applying unit which applies a voltage to said sweep roller;
- a rotation driving unit which drives to rotate said sweep roller;
- 15 a contact/separation unit which brings said sweep roller into contact with and separates said roller from said latent image carrier; and
- a cleaning unit which cleans said sweep roller.

20 16. The liquid developing device according to claim 15, wherein said nip forming unit forms a nip by a pressure control unit for controlling a pressure of said sweep roller against said latent image carrier.

17. The liquid developing device according to claim 16,
wherein said pressure control unit has a mechanism that
adjusts a pressure.

5 18. The liquid developing device according to claim 15,
wherein said sweep voltage applying unit which applies a
voltage to said sweep roller is formed of a conductive biasing
member, and said biasing member comes into contact with said
sweep roller to apply a sweep voltage thereto.

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19. The liquid developing device according to claim 18,
wherein said sweep voltage applying unit has a conductive
wearing member provided on a contact surface with said sweep
roller so that a contact part between said sweep roller and
15 said sweep voltage applying unit always wears.

20. The liquid developing device according to claim 18,
wherein said sweep voltage applying unit applies a sweep
voltage to said sweep roller by coming into contact with
20 a core metal of said sweep roller.

21. The liquid developing device according to claim 15,
wherein said rotation driving unit has a latent image carrier
end gear disposed in the end part of said latent image carrier;
25 and a sweep roller end gear disposed in the end part of said

sweep roller so as to be engaged with said latent image carrier end gear, and

said sweep roller end gear drives to rotate said sweep roller.

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22. The liquid developing device according to claim 21, wherein said rotation driving unit drives to rotate said sweep roller so that a surface moving speed of said sweep roller is substantially the same as a surface moving speed 10 of said latent image carrier.

23. The liquid developing device according to claim 21, wherein said rotation driving unit has a one way clutch disposed in said sweep roller end gear.

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24. The liquid developing device according to claim 15, wherein said contact/separation unit is so constructed that said sweep roller is separated from said latent image carrier by a displacing device and said sweep roller is brought into 20 contact with said latent image carrier by a pressure control unit.

25. The liquid developing device according to claim 24, wherein said contact/separation unit is so constructed that 25 said displacing device has a cam and said sweep roller

separates from said latent image carrier through rotation
of said cam.

26. The liquid developing device according to claim 15,
5 wherein said sweep roller is formed in a multilayer structure
including a core metal and at least one layer.

27. The liquid developing device according to claim 26,
wherein said sweep roller formed of an elastic body has a
10 volume resistivity of 10^9 ohms-cm or below.

28. The liquid developing device according to claim 26,
wherein said sweep roller formed of an elastic body has a
hardness of 50 degrees (JIS-A) or below.

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29. The liquid developing device according to claim 26,
wherein said sweep roller formed of an elastic body does
not swell by carrier liquid of developer, nor is impregnated
with said carrier liquid.

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30. The liquid developing device according to claim 26,
wherein the surface layer of said sweep roller formed of
an elastic body is a film layer of 100 μm or below.

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31. The liquid developing device according to claim 26, wherein said sweep roller surface layer formed of an elastic body is a film layer having a volume resistivity of 10^9 ohms-cm or below.

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32. The liquid developing device according to claim 15, further comprising:

a development voltage applying unit which applies a voltage to a developer carrier, said voltage producing an electric field between an image portion of a latent image carrier and said developer carrier, and said electric field having a direction that moves toner to said image portion;
10 and

a sweep voltage applying unit which applies a voltage to a sweep roller, said voltage producing an electric field having a direction that attracts stray excess toner present between a background of said latent image carrier and said sweep roller to said sweep roller, and said electric field being not so strong as said toner adhering to said image
20 portion is peeled.

33. The liquid developing device according to claim 15, wherein a surface moving speed of a developer carrier is substantially the same as a surface moving speed of said latent image carrier.
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34. A liquid image formation apparatus comprising:

a latent image carrier;

a latent image forming unit which forms a latent image on said latent image carrier;

5 a developing unit which visualizes the latent image on said latent image carrier; and

a transfer unit which transfers the visualized image on said latent image carrier to a transfer material, said liquid image formation apparatus further comprising a liquid 10 developing device,

said liquid developing device including:

at least one developer carrier which carries a highly viscous and highly concentrated liquid developer consisting of a carrier liquid and toner dispersed therein;

15 and

an applying member which applies said liquid developer to said developer carrier,

said liquid developing device for developing the latent image formed on said latent image carrier by said 20 liquid developer carried on said developer carrier, said liquid developing device further including:

at least one sweep roller formed of an elastic body for removing excess developer on said latent image carrier after development, located downstream said 25 developer carrier in a direction in which the surface of

said latent image carrier moves;

 a nip forming unit which forms a nip between
 said sweep roller and said latent image carrier;

5 a sweep voltage applying unit which applies a
 voltage to said sweep roller;

 a rotation driving unit which drives to rotate
 said sweep roller;

10 a contact/separation unit which brings said
 sweep roller into contact with and separates said roller
 from said latent image carrier; and

 a cleaning unit which cleans said sweep roller.

35. The liquid image formation apparatus according to
claim 34, wherein said sweep roller is separated from said
15 latent image carrier when the liquid developing device or
liquid image formation apparatus is not in use.

36. A liquid developing device comprising:

20 at least one developer carrier which carries a highly
 viscous and highly concentrated liquid developer consisting
 of a carrier liquid and toner dispersed therein; and

 an applying member which applies said liquid developer
 to said developer carrier,

25 said liquid developing device for developing a latent
 image formed on a latent image carrier by said liquid

developer carried on said developer carrier, further comprising:

at least one removing member which removes excess toner and carrier on said latent image carrier after development,

5 located downstream said developer carrier in a direction in which the surface of said latent image carrier moves; and a cleaning unit that cleans the surface of said removing member as a roller,

wherein said cleaning unit is a blade member, and its

10 contact position with respect to said roller as said removing member is a central position or lower in the vertical direction.

37. The liquid developing device according to claim 36,

15 wherein said cleaning blade is disposed so that said cleaning blade is in contact with said sweep roller at a position having an angle θ formed with a horizontal surface of said sweep roller, and said cleaning blade is in contact with said sweep roller at an angle α formed between a tangential

20 direction at a contact point of said blade with said sweep roller and said blade, and the angle θ is made greater than the angle α .

38. The liquid developing device according to claim 36,
wherein said cleaning unit is a rubber member having a JISA
hardness within a range from 50 degrees to 80 degrees.

5 39. The liquid developing device according to claim 36,
wherein the elastic constant of a material for said cleaning
unit is within a range from 100 MPa to 5000 MPa.

10 40. The liquid developing device according to claim 36,
wherein said cleaning unit has a blade formed of an elastic
body, that has a JISA hardness within a range from 50 degrees
to 80 degrees, bonded to a thin plate as a rigidity imparting
member.

15 41. The liquid developing device according to claim 36,
wherein said cleaning member is subjected to oil-repellent
treatment.

20 42. The liquid developing device according to claim 36,
further comprising a conveying unit, which moves toner after
being removed in an axial direction, disposed close to said
cleaning blade.

43. The liquid developing device according to claim 36, wherein an angle of said cleaning blade is formed in a minus direction with respect to a vertical direction, and a moving member is disposed in the vicinity of said cleaning blade.

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44. The liquid developing device according to claim 36, wherein said cleaning blade and its holding part are electrically floated from the main body of said device, and a bias is applied to said cleaning blade so that the potential 10 is substantially the same as that of a developer carrier.

45. The liquid developing device according to claim 36, wherein said cleaning blade and its holding part are electrically floated from the main body of said device when 15 the material of said cleaning blade has an electrical resistivity of 10^{12} ohms or above, and this part is grounded.

46. A liquid developing device comprising a developer carrier which carries a liquid developer consisting of a 20 carrier liquid and toner dispersed therein, said liquid developing device for supplying said liquid developer carried on said developer carrier to a latent image carrier to develop a latent image, further comprising:

at least one sweep roller, which removes excess liquid 25 developer adhering to the surface of said latent image

carrier after development, located downstream the surface of said latent image carrier, wherein said sweep roller is formed of an elastic body.

5 47. The liquid developing device according to claim 46, wherein cylindrical members each having a smaller outer diameter than the outer diameter of said sweep roller are provided in both ends of said sweep roller, and a nip width, formed when said sweep roller is brought into contact with
10 said latent image carrier, is adjusted to an appropriate one.

48. The liquid developing device according to claim 46, wherein said sweep roller is formed in a multilayer structure
15 including a core metal and an elastic layer with at least one layer.

49. The liquid developing device according to claim 48, wherein said sweep roller has a volume resistivity of 10^9
20 ohms-cm or below.

50. The liquid developing device according to claim 48, wherein said sweep roller formed of said elastic body has a hardness of 50 degrees (JIS-A) or below.

51. The liquid developing device according to claim 48, wherein said sweep roller formed of said elastic body does not swell by said carrier liquid, nor is impregnated with said carrier liquid.

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52. The liquid developing device according to claim 48, wherein the surface of said sweep roller has a surface roughness value of 3 μm or below.

10 53. The liquid developing device according to claim 48, wherein said elastic layer is formed of urethane base resin as its main component.

15 54. The liquid developing device according to claim 48, wherein the surface of said sweep roller is a film layer of 100 μm or below.

20 55. The liquid developing device according to claim 48, wherein the surface of said sweep roller is a film layer having a volume resistivity of 10^9 ohms-cm or below.

56. The liquid developing device according to claim 48, wherein said elastic body is a foam.

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57. The liquid developing device according to claim 48,
wherein said elastic layer is formed of silicone base resin
as its main component.

5 58. The liquid developing device according to claim 46,
further comprising:

a development voltage applying unit which applies a
voltage to said developer carrier, said voltage producing
an electric field having a direction that moves liquid
10 developer to said latent image carrier when a latent image
on said latent image carrier is developed with said liquid
developer carried on said developer carrier; and

a sweep voltage applying unit which applies a voltage
to said sweep roller, said voltage producing an electric
15 field having a direction that attracts excess liquid
developer or toner to said sweep roller in order to remove
said excess liquid developer or toner adhering to or floating
around the surface of said latent image carrier or its
periphery after development, and said electric field being
20 not so strong as said toner adhering to the developed latent
image on said latent image carrier is peeled.

59. The liquid developing device according to claim 46,
wherein a surface moving speed of said developer carrier
25 is substantially the same as a surface moving speed of said

latent image carrier.

60. The liquid developing device according to claim 46,
wherein a surface moving speed of said sweep roller is
5 substantially the same as a surface moving speed of said
latent image carrier.

61. The liquid developing device according to claim 46,
wherein said toner contains pigment, and a thickness of a
10 liquid developer to be applied to said developer carrier
is set so that a pigment content in said toner carried on
the surface of said developer carrier per square cm is within
a range from 0.1 μ g to 2 μ g.

15 62. The liquid developing device according to claim 46,
further comprising a cleaning unit which cleans the surface
of said developer carrier; and a cleaning unit which cleans
the surface of said sweep roller.

20 63. The liquid developing device according to claim 46,
wherein said developer carrier is a belt-like carrier.

64. The liquid developing device according to claim 63,
wherein said developer carrier has a hardness of 60 degrees
25 (JIS-A) or below.

65. The liquid developing device according to claim 46,
wherein said developer carrier is a roller-like carrier.

66. The liquid developing device according to claim 65,
5 wherein said developer carrier has a hardness of 40 degrees
(JIS-A) or below.

67. The liquid developing device according to claim 65,
wherein an electrical resistivity between the surface of
10 said roller-like developer carrier and a roller shaft of
said developer carrier is 10^9 ohms or below.

68. A liquid image formation apparatus comprising: a
latent image carrier; a latent image forming unit which forms
15 a latent image on said latent image carrier; a developing
unit which visualizes the latent image on said latent image
carrier; and a transfer unit which transfers the visualized
image on said latent image carrier to a transfer material,
said liquid image formation apparatus using a liquid
20 developing device,

 said liquid developing device including:
 a developer carrier, as said developing unit, which
 carries a liquid developer consisting of a carrier liquid
 and toner dispersed therein, said liquid developing device
25 for supplying said liquid developer carried on said developer

carrier to said latent image carrier to develop a latent image, said device further including:

at least one sweep roller, which removes excess liquid developer adhering to the surface of said latent image carrier after development, located on the downstream side of the surface of said latent image carrier, wherein said sweep roller is formed of an elastic body.

69. A liquid developing device comprising a developer carrier which carries a liquid developer consisting of a carrier liquid and toner dispersed therein, said liquid developing device for supplying said liquid developer carried on said developer carrier to a latent image carrier to develop a latent image,

wherein said developer carrier is formed of urethane base resin so as to have conductivity, and

at least one sweep roller, which removes excess liquid developer adhering to the surface of said latent image carrier after development, is provided on the downstream side of the surface of said latent image carrier.

70. The liquid developing device according to claim 69, wherein said developer carrier is a belt-like carrier.

71. The liquid developing device according to claim 70,
wherein said developer carrier has a hardness of 60 degrees
(JIS-A) or below.

5 72. The liquid developing device according to claim 69,
wherein said developer carrier is a roller-like carrier.

73. The liquid developing device according to claim 72,
wherein said developer carrier has a hardness of 40 degrees
10 (JIS-A) or below.

74. The liquid developing device according to claim 72,
wherein an electrical resistivity between the surface of
said roller-like developer carrier and a roller shaft of
15 said developer carrier is 10^9 ohms or below.

75. The liquid developing device according to claim 69,
wherein the surface of said developer carrier has a surface
roughness value of 3 μm or below.

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76. The liquid developing device according to claim 69,
wherein a conductive surface layer is provided on said
developer carrier.

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77. The liquid developing device according to claim 69,
wherein the surface of said latent image carrier is formed
of amorphous silicon.

5 78. The liquid developing device according to claim 69,
further comprising:

a development voltage applying unit which applies a
voltage to said developer carrier, said voltage producing
an electric field having a direction that moves said liquid
10 developer to said latent image carrier when a latent image
on said latent image carrier is developed with said liquid
developer carried on said developer carrier; and

a sweep voltage applying unit which applies a voltage
to said sweep roller, said voltage producing an electric
15 field having a direction that attracts excess liquid
developer or toner to said sweep roller in order to remove
said excess liquid developer or toner adhering to or floating
around the surface of said latent image carrier or its
periphery after development, and said electric field being
20 not so strong as said toner adhering the developed latent
image on said latent image carrier is peeled.

79. The liquid developing device according to claim 69,
wherein a surface moving speed of said developer carrier
25 is substantially the same as a surface moving speed of said

latent image carrier.

80. The liquid developing device according to claim 69,
wherein a surface moving speed of said sweep roller is
5 substantially the same as a surface moving speed of said
latent image carrier.

81. The liquid developing device according to claim 69,
wherein said toner contains pigment, and a thickness of a
10 liquid developer to be applied to said developer carrier
is set so that a pigment content in said toner carried on
the surface of said developer carrier per square cm is within
a range from 0.1 μ g to 2 μ g.

15 82. The liquid developing device according to claim 69,
further comprising a cleaning unit which cleans the surface
of said developer carrier; and a cleaning unit which cleans
the surface of said sweep roller.

20 83. A liquid image formation apparatus comprising: a
latent image carrier; a latent image forming unit which forms
a latent image on said latent image carrier; a developing
unit which visualizes the latent image on said latent image
carrier; and a transfer unit which transfers the visualized
25 image on said latent image carrier to a transfer material,

said liquid image formation apparatus using a liquid developing device,

 said liquid developing device comprising:

 a developer carrier as said developing unit which
5 carries a liquid developer consisting of a carrier liquid
 and toner dispersed therein, said liquid developing device
 for supplying said liquid developer carried on said developer
 carrier to said latent image carrier to develop a latent
 image,

10 wherein said developer carrier is formed of urethane
 base resin so as to have conductivity, and

 at least one sweep roller, which removes excess liquid
 developer adhering to the surface of said latent image
 carrier after development, is provided on the downstream
15 side of the surface of said latent image carrier.